

Application No. 10/595,733
Amendment Dated 11/18/10
Reply to Office Action of 6/18/10

REMARKS

This Amendment is submitted in response to the Office Action mailed on June 18, 2010. Claims 19, 21-28 and 30-46 have been amended, and claims 20 and 29 have been canceled without prejudice or disclaimer. Claims 19, 21-28 and 30-46 remain pending in the present application. In view of the foregoing amendments, as well as the following remarks, Applicants respectfully submit that this application is in complete condition for allowance and request reconsideration of the application in this regard.

Rejections Under 35 U.S.C. §112, First Paragraph

While Applicants respectfully traverse Examiner's rejections of claims 19-46 under 35 U.S.C. §112, first paragraph, Applicants have amended each of independent claims 19 and 30 to recite that the workpiece fixture is configured to "move" the workpiece between operating windows of the first and second laser removal devices (claim 19) and that the workpiece is "moved" without changing the clamping between operating windows of the first and second laser removal devices (claim 30). Consequently, the rejections of claims 19-46 under 35 U.S.C. §112, first paragraph, are now moot and should be withdrawn.

Rejections Under 35 U.S.C. §112, Second Paragraph

With respect to the rejections of claims 19-46 under 35 U.S.C. §112, second paragraph, Applicants have amended the pending claims to overcome these rejections as will be appreciated by the Examiner.

Application No. 10/595,733
Amendment Dated 11/18/10
Reply to Office Action of 6/18/10

With respect to the particular rejection of claims 19-46 for reciting a “laser removing device,” Applicants submit that one of ordinary skill in the art would readily understand that the word “laser” preceding the words “removing device” is used to qualify the type of removing device (i.e., it employs a laser) rather than it describing a device that removes a laser as argued by the Examiner. In any event, independent claims 19 and 30 have been amended to now recite first and second laser removing devices having first and second laser beams so that these particular rejections are overcome.

With respect to the particular rejection of dependent claim 24, Applicants respectfully submit that one of ordinary skill in the art, in view of Applicants’ disclosure, would readily understand that the recited “control” is a device for controlling the first and second laser removing devices and so this particular rejection is improper and should be withdrawn.

With respect to the particular rejection of dependent claim 26, Applicants have amended this claim to recite an interface “communicating” between the first and second controls. One of ordinary skill in the art would readily understand that the interface comprises an electrical communication between the first and second controls so that the rejection should be withdrawn.

Lastly, with respect to the particular rejection of claim 29, Applicants respectfully submit that the term “quality-switched solid-state laser” is a term of art as

Application No. 10/595,733
Amendment Dated 11/18/10
Reply to Office Action of 6/18/10

readily understood by those of ordinary skill in the art. Accordingly, this rejection is improper and should be withdrawn.

Rejection Under 35 U.S.C. §103(a)

Claims 19-46 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Applicant's alleged Prior Art in view of *Hong et al.*, U.S. Patent Application Publication No. 2003/0006221 ("*Hong et al.*"), *Inagawa et al.*, U.S. Patent No. 5,126,532 ("*Inagawa et al.*") and *Krause et al.*, U.S. Patent No. 6,827,988 ("*Krause et al.*"). Claims 22, 33 and 34 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Applicants' alleged Prior Art in view of *Hong et al.*, *Inagawa et al.*, *Krause et al.* and *Henderson*, U.S. Patent No. 5,338,645 ("*Henderson*"). Lastly, claim 26 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Applicants' alleged Prior Art in view of *Hong et al.*, *Inagawa et al.*, *Krause et al.* and *Manor*, U.S. Patent No. 6,562,698 ("*Manor*"). While Applicants respectfully traverse these rejections, Applicants have amended each of independent claims 19 and 30 to even more sharply define the claimed invention over the prior art of record and respectfully request that the rejections be withdrawn.

Before turning to the specific rejections, Applicants wish to provide the Examiner with a background or context of the present invention. To that end, it has been known in the past to produce a formation on a substrate using the techniques of laser drilling to form a through hole and layerwise ablation for other portions of the formation (e.g., a funnel part in communication with the through hole).

According to one known approach as described in the Background section of Applicants' disclosure, such a formation has been made using a single laser that is operated at a first parameter to create the through hole and at a second parameter to form the funnel portion.

The other conventional approaches are either to have two different laser heads mounted one after another onto the same mounting or to have two different machines, with one configured for laser drilling and the other configured for removing material of the workpiece in layers.

In the known prior art approaches, a problem may occur when the workpiece is moved from one station performing the drilling process to the other station performing the layerwise ablation, or vice versa, as it leads to intolerable inaccuracies in view of machining accuracy. For example, if machining accuracy in a conventional machine is, by way of example, 1000 μm , then a mounting inaccuracy of 30 μm is tolerable. But, on the other hand, if the machining accuracy is 10 μm , by way of example, then the same mounting accuracy of 30 μm would completely destroy and invalidate the machining accuracy.

To overcome the problem of re-mounting the workpiece in the first and second stations (i.e., the drilling and laser ablation stations), others have employed two exchangeable laser heads in the same machine as described above for performing the drilling and layerwise ablation steps. However, because of the inaccuracy problems discussed above, the mounting inaccuracy problem would only be shifted away from

the workpiece side, wherein the workpiece is remounted in two different stations, to the dual laser head side, wherein two exchangeable laser heads are mounted sequentially into the same mounting.

The present invention, as recited in each of independent claims 19 and 30, overcomes the known problems associated with conventional approaches for conducting laser drilling and layerwise ablation on a workpiece. As recited in each of independent claims 19 and 30, a first laser removing device having a first laser beam is used for laser drilling a workpiece and a second laser removing device having a second laser beam is used for removing material of the workpiece in layers. A workpiece fixture is configured to move the workpiece between operating windows of the first and second laser removal devices. In this way, a laser machining apparatus having both the first and second laser removing devices for drilling and removing material of the workpiece in layers is provided wherein the workpiece is moved between operating windows of the first and second laser removal devices rather than requiring the workpiece to be remounted in two different machines or two laser heads to be sequentially mounted onto a single mounting as is known in the prior art.

Turning now to the prior art rejections, and in particular to the rejections of independent claims 19 and 30 as being unpatentable over Applicants' alleged Prior Art (APA) in view of *Hong et al.*, *Inagawa et al.* and *Krause et al.*, Applicants submit that Applicants' alleged Prior Art (APA) describes a machine that uses a single laser head

Application No. 10/595,733
Amendment Dated 11/18/10
Reply to Office Action of 6/18/10

operating at two different parameters to sequentially perform the laser drilling and layerwise ablation processes.

The *Hong et al.* reference is directed to an apparatus that includes two lasers for cutting different layers of a substrate to form a cut through an entire thickness of the substrate. One of the lasers is focused on a first substrate layer and the other laser is focused on a second layer so as to ablate the layers. As described in *Hong et al.*, the two lasers are provided to cut or singulate a package having individual IC units so as to separate each individual IC unit. So, in *Hong et al.*, the purpose of the two lasers is for cutting a substrate using laser irradiation so as to form a cut through the entire thickness of the substrate. See Paragraphs [0005] and [0029].

Applicants submit that *Hong et al.* is completely silent with respect to a laser machining apparatus comprising a first laser removing device for laser drilling a workpiece and a second laser removing device which removes material in layers on the same workpiece.

Since *Hong et al.* is solely directed to cutting a substrate using laser irradiation, one of ordinary skill in the art would have no motivation to substitute one of the lasers of *Hong et al.* to remove material in layers since this would clearly destroy the intended purpose and function of the *Hong et al.* apparatus to cut through the entire thickness of a substrate using two lasers.

Inawaga et al. is directed to a laser boring apparatus that forms a bore or through hole through a substrate using two lasers (2, 4). In each of the different

Application No. 10/595,733
Amendment Dated 11/18/10
Reply to Office Action of 6/18/10

embodiments of the *Inawaga et al.* laser boring apparatus, the substrate (16) remains stationary while the bore is formed in a two-step boring process by the lasers (2, 4). *Inawaga et al.* is therefore completely silent with respect to a second laser removing device that is configured to remove material of the workpiece in layers as recited in each of independent claims 19 and 30. *Inawaga et al.* is also completely silent with respect to moving a workpiece between operating windows of first and second laser removal devices as claimed.

Lastly, the *Krause et al.* reference actually teaches away from the present invention as recited in each of independent claims 19 and 30 since it is directed to laser sintering selected portions of a ceramic material with a laser beam which builds up material rather than removing the material in layers as occurs with the second laser removing device as recited in each of independent claims 19 and 30.

In view of the above, Applicants respectfully submit that the rejections of independent claims 19 and 30 are improper and should be withdrawn.

Moreover, as claims 21-28 and 31-46 depend from allowable independent claims 19 and 30, and further as each of these claims recites a combination of elements or steps not fairly taught or suggested by the prior art of record, Applicants submit that these claims are allowable as well.

Application No. 10/595,733
Amendment Dated 11/18/10
Reply to Office Action of 6/18/10

CONCLUSION

In view of the foregoing response including the amendments and remarks, this application is submitted to be in complete condition for allowance and early notice to this affect is earnestly solicited. If there is any issue that remains which may be resolved by telephone conference, Examiner is invited to contact the undersigned in order to resolve the same and expedite the allowance of this application.

Please see the electronic fee calculation sheet for the charge in the amount of \$490 for the two months extension fee as required by 37 C.F.R. §1.17(a)(2). If any other fees are necessary, the Commissioner is hereby authorized to charge any underpayment or fees associated with this communication or credit any overpayment to Deposit Account No. 23-3000.

Respectfully submitted,

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